LASER BURN-IN TESTING

Inventors: Fang-Zhong Chen, Wei Cai, John Chen, Chun Lei, and Robert Shih

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates generally to testing of laser diodes.

2. Description of Background Art

[0002] Burn-in procedures are commonly utilized in laser diode manufacturing. Commonly, laser diodes are tested at an elevated ambient temperature for an extended period of time to assess how the lasers degrade over time. For example, a burn-in procedure may be used to screen out infant mortality and to estimate long-term reliability.

[0003] Conventionally, lifetesting of laser diodes involves periodically testing the laser diodes at room temperature. For example, in a 1000 hour test the lasers may be operated at elevated temperature but removed every 50-100 hours to test individual lasers.

[0004] A drawback of conventional lifetesting is that it is labor intensive. Therefore, what is desired is an improved apparatus and method for lifetesting laser diodes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a plan view of a burn-in rack having a burn-in board for holding laser diodes.

[0006] FIG. 2 is a plan view of a test apparatus having a detector array.

[0007] FIG. 3 illustrates a burn-in rack inserted into the test apparatus.

[0008] FIG. 4 is a flow chart one method of liftesting.

[0009] FIG. 5 is a flow chart illustrating another method of lifetesting.

[0010] The figures depict a preferred embodiment of the present invention for purposes of illustration only. One of skill in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods disclosed herein may be employed without departing from the principles of the claimed invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] The present invention generally comprises an apparatus and method for lifetesting laser diodes. Referring to FIG. 1, a burn-in rack 100 comprises a board 105 having a plurality of holders 120 for laser diode packages, such as lasers packaged in TO packages. Signal buses 115 permit electrical signals to be coupled to an electrical connector 110 and laser diodes mounted in holders 120. A handle 150 may be included to facilitate moving the burn-in rack into a burn-in oven. FIG. 1 shows a small number of holders 120 for the purposes of illustration, however in some embodiments 50 or more holders are included on the burn-in rack. The holders are preferably arranged as an array or other efficient arrangement for placing laser diodes on a board.

[0012] Referring to FIG. 2, in the present invention a test apparatus 200 includes an arrangement of optical detectors 220 having the same spatial relationship as the holders 120 of the burn-in rack 100. The optical detectors are preferably calibrated optical detectors. Each optical detector is electrically coupled, such as by a signal bus 215, to an electrical connector 220. A frame (not shown in FIG. 2) is preferably included in the test

apparatus 200 to permit the burn-in rack 100 to be mounted with laser diodes in close proximity to detectors 220. In one embodiment the frame is configured to permit the burn-in rack to be slid into place.

[0013] FIG.3 illustrates the use of the test apparatus as part of a lifetesting system. An entire burn-in rack 100 with mounted laser diodes is placed onto frame 290. Light from each laser diode mounted to the burn-in rack will be received by a corresponding optical detector of test apparatus 200. In one embodiment, a computer 305 is communicatively coupled to the lasers and the detectors via electrical connectors 110 and 220. Computer 305 may, for example, include associated signal drivers and detectors appropriate for the laser diodes and detectors. Computer 305 may test each laser, such as by performing a L-I (light power versus current) analysis using the detectors in test apparatus 200 to detect light power. In one embodiment computer 305 test each laser diode in a sequence until it has tested all of the laser diodes.

[0014] Packaged laser diodes sometimes also include an internal monitor photo-diode. In some embodiment, computer 305 also monitors the output of the monitor photo-diode as well.

[0015] Computer 305 may display the results of a test on a computer screen. Additionally, test results may also be stored, such as on the memory of the computer, for later use during lifetesting.

[0016] FIG. 4 illustrates one method of using the test apparatus. In one embodiment, a burn-in board having a plurality of laser diodes is mounted 405 to the test apparatus. Each laser diode is characterized 410 using the optical detectors of the test apparatus. The characterization data is preferably stored 420 for later use. A decision is made 430 whether the lasers on the burn-in board require additional burn-in at elevated

temperature. If the lasers require more burn-in, the entire burn-in board may be inserted 440 into a burn-in oven for a preselected time and temperature. The process may be cycled for a selected number of iterations until the lasers have been burned for the desired length of time.

[0017] FIG. 5 illustrates another method of using the test apparatus. A burn in board with laser diodes is mounted 505 onto the test apparatus. The laser diodes are characterized 510 using the calibrated optical detectors of the test apparatus. Each laser diode is also characterized using its own integrated monitor detector 515. Each integrated monitor detector is then calibrated 520 using the characterization date from the calibrated optical detectors of the test apparatus. This may, for example, include using measured power levels to determine the mathematical relationship between an output current or voltage of the monitor detectors and the actual output power levels. This calibration process is of general interest as characterization data for end users but may also be used in later lifetesting. The burn-in board may then be removed and placed in a burn-in oven 525. The monitor detectors of each laser may then be used to characterize the lasers during further lifetesting 530. In some embodiments, this permits, for example, further periodic testing of the laser diodes at room temperature using the monitor detectors. Additionally, useful information on laser degradation may also be acquired during elevated temperature testing using the calibrated monitor diodes.

[0018] One benefit of the present invention is that it reduces labor cost. Once laser diodes are mounted onto the holders of a burn-in rack they may be left in place throughout subsequent lifetesting. For example, with a laser burn-in rack with 50 laser diodes it may be desired to monitor the L-I degradation of the laser at periodic intervals, such as every 100 hours during an extended lifetest. Conventionally, during each test

interval all of the laser diodes would have to be removed from the burn-in rack, individually tested, and returned to the burn-in rack. In the present invention, the laser diodes can be left on the burn-in rack and tested, reducing labor cost. Additionally, in embodiments in which the test apparatus is used to calibrate the monitor detectors of the lasers, the laser diodes can be characterized using the monitor detectors.

[0019] While particular embodiments and applications of the present invention have been illustrated and described, it is to be understood that the invention is not limited to the precise construction and components disclosed herein and that various modifications, changes and variations which will be apparent to those skilled in the art may be made in the arrangement, operation and details of the method and apparatus of the present invention disclosed herein without departing from the spirit and scope of the invention as defined in the appended claims.